



Key technologies for tomorrow: the High-Tech Agenda Germany



An initiative of:



Federal Ministry
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and Space

Research in
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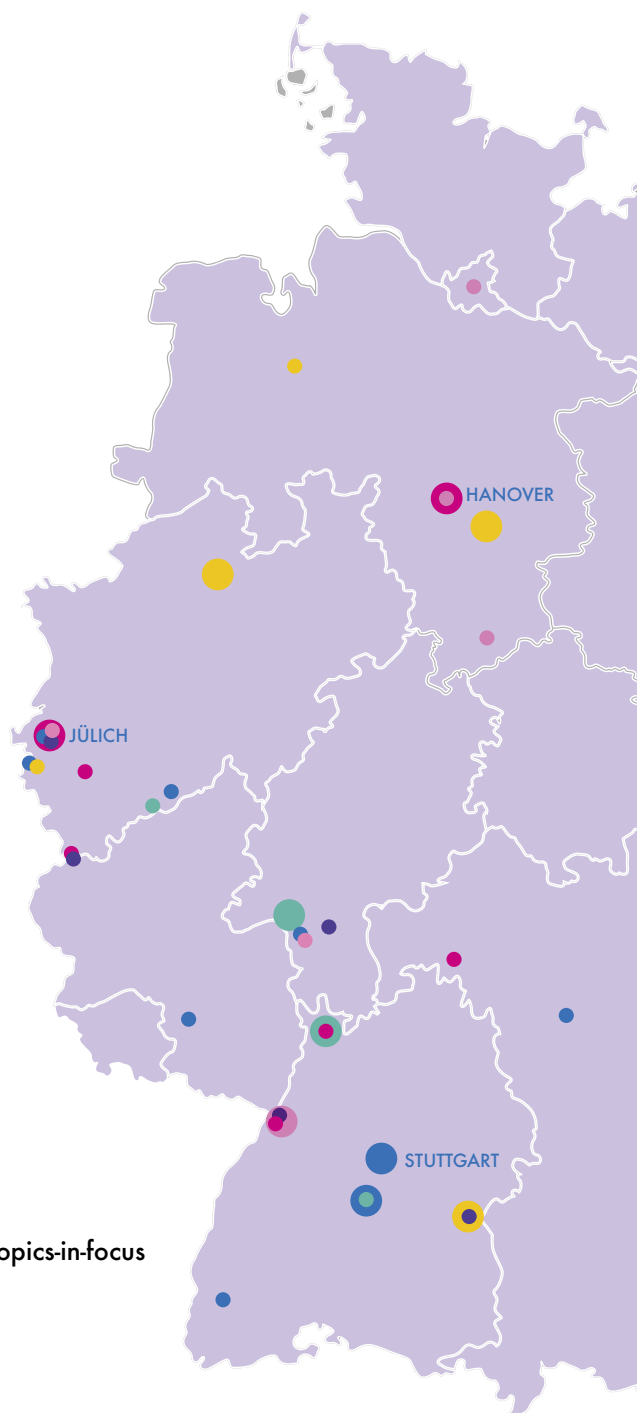
Land of Ideas

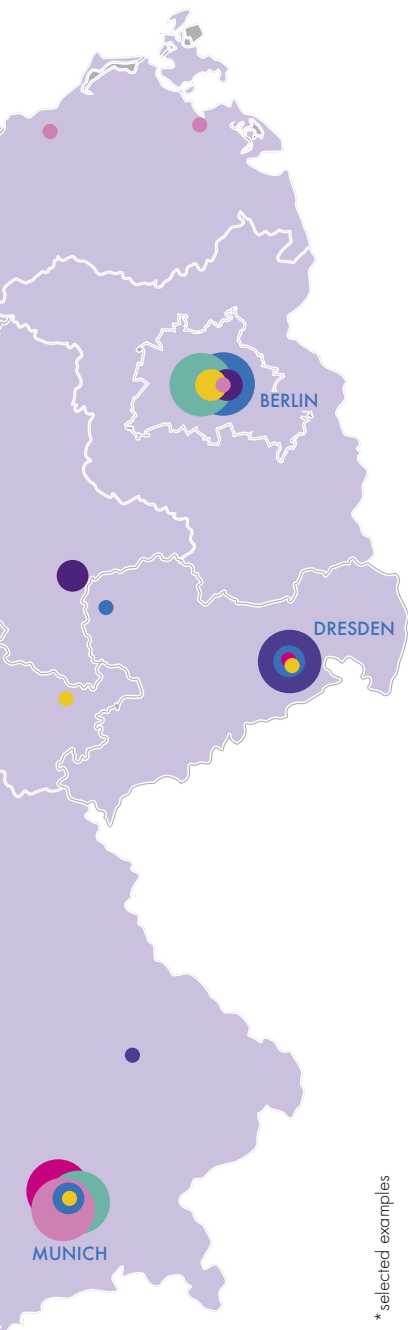
Germany's high-tech hotspots: key actors, hubs and research institutions*

- Artificial intelligence (AI)
- Quantum technologies
- Microelectronics
- Biotechnology
- Fusion and climate-neutral energy generation
- Technologies for climate-neutral mobility

Scan this QR code to view all
the research institutions across
the different key technologies
on the map:

research-in-germany.org/research-topics-in-focus





* selected examples

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Driving innovation, shaping tomorrow: the High-Tech Agenda Germany

Germany's High-Tech Agenda is all about boosting competitiveness, creating additional value and achieving greater independence through research and innovation. By significantly investing in key future technologies, the country is launching an innovation drive – with the High-Tech Agenda laying the foundation and creating the funding structures necessary to bring the country to the forefront of global technological development.

THE HIGH-TECH AGENDA GERMANY DRIVES INNOVATION THROUGH SIX KEY TECHNOLOGIES:



Artificial intelligence (AI):

AI for smart solutions in business, science and society



Quantum technologies:

quantum power for computing performance, security and innovation



Microelectronics:

high-performance chips as the basis for high-tech solutions



Biotechnology:

sustainable products and processes for health and the environment



Fusion and climate-neutral energy generation:

new approaches to sustainable energy generation



Technologies for climate-neutral mobility:

battery technology as a key prerequisite for the mobility of the future

**IN ADDITION, PROJECTS ARE
BEING CARRIED OUT IN FIVE
STRATEGIC RESEARCH FIELDS:**



Aerospace research



Health research



Security and
defence research



Marine, climate and
sustainability research



Humanities and
social sciences

In each of these areas,
Germany boasts an inter-
nationally competitive science
and research system, a high
level of technological capability
and innovative companies.

How does the High-Tech Agenda Germany plan to achieve these goals?

For each key technology, individual roadmapping processes with concrete timelines and key milestones were developed as a part of a participatory initiative: in a total of 26 dialogues ("Partnerdialoge"), experts from science, business and civil society worked alongside representatives of Germany's federal and state governments to draw up these roadmaps.



More:
High-Tech Agenda Germany –
Roadmaps



Funding opportunities (selection):
Funding database at federal, state
and EU level (in German only)



PRIMARY GOALS

■ Artificial intelligence (AI):

To become a world-leading centre for AI in collaboration with European partners.

■ Quantum technologies:

To implement quantum computing at the top European level, to promote the application of quantum sensor technology and to expand quantum communication.

■ Microelectronics:

To strengthen security of supply by investing in chip design and production and ensuring research is translated into practical applications.

■ Biotechnology:

To become a top location for health research and the world's most innovative centre for biotechnology.

■ Fusion and climate-neutral energy generation:

To become a leading innovation hub for fusion technologies and to invest heavily in technologies for geothermal energy, green hydrogen and corresponding infrastructure.

■ Technologies for climate-neutral mobility:

To establish competitive battery production and cycle management and to play a central role in global competition for the next generation of batteries. Furthermore, Germany is poised to become a leading provider of technologies for alternative drive technologies and climate-friendly fuels in Europe.



Artificial intelligence: bright minds, powerful technologies

Artificial intelligence will have a profound and far-reaching impact on the future of our economy and society. As its role grows across virtually all areas of research, Germany intends to be at the forefront of AI development. It's where world-class research is conducted, where some of the brightest young talents are trained and where you'll find outstanding research infrastructure and companies that are seriously invested in R&D.



Where Germany excels

IN RESEARCH

- AI research at top global level, for example at the RWTH Center for Artificial Intelligence
- diverse, internationally well-connected AI research landscape: the German Research Center for Artificial Intelligence (DFKI), the research institutes of Fraunhofer, the Max Planck Society and the Helmholtz Association, and AI university research institutes

- strong research base in AI publications: Germany ranks 5th worldwide
- human-centric focus in AI development

IN INDUSTRY

- high level of industry expertise in using AI: 95 per cent of German companies plan to invest in AI and machine learning (ML) in the next 5 years
- a vibrant AI scene: 935 innovative AI start-ups a year
- expertise in data protection, certification and governance

IN INFRASTRUCTURE

- strong AI computing infrastructure, e.g. JUPITER, one of the world's most powerful supercomputers
- AI service centres and one-stop shops
- 6 national Centres of Excellence for AI research
- access to European data spaces

IN SOCIETY

- strong open-source community
- generally positive attitude towards AI



Where Germany is heading

Leveraging these competitive advantages, Germany intends to work together with its European partners to become one of the world's leading centres for AI. The roadmap to achieve this sets out the milestones up to 2030:

1. BOOSTING THE VALUE CREATED THROUGH AI

- setting up test centres and real-world laboratories for AI applications by 2028
- establishing Germany as a leading market for industrial AI by 2030
- ensuring that 10 per cent of economic output is AI-based by 2030

2. IMPROVING AI CAPACITIES

- expanding the Gauss Centre for Supercomputing by 2027
- building an EU AI Gigafactory by 2028
- expanding data centres: doubling computing capacity by 2030
- creating data ecosystems by 2030





3. BECOMING A KEY PLAYER FOR THE NEXT GENERATION OF AI

- providing access to powerful AI foundation models by 2027
- establishing European frontier AI labs by 2028
- developing proprietary, domain-specific AI systems by 2029
- developing a frontier AI model by 2030

4. EXPANDING THE USE OF AI IN HEALTHCARE

- setting up real-world labs to evaluate AI health data-based training methods compliant with data protection laws by 2027
- implementing test environments in healthcare facilities by 2029
- ensuring that pseudonymised health data from various sources can be linked for research purposes by 2029

More: Artificial intelligence roadmap (in German only)



Funding opportunities (selection):

- Funding announcements and competitions (in German only)

The “Plattform Lernende Systeme” publishes current announcements of AI funding programmes, such as the funding guideline for the development of robo-hubs under the German government’s AI Robotics Booster.

Discover current AI research, individual funding opportunities and leading institutions in Germany using the QR code for all direct links on the last page.

Quantum technologies: faster, smarter, more precise

Quantum technologies promise to revolutionise all kinds of fields – accelerating the discovery of new medicines and materials, enabling navigation without GPS and making data transmission virtually impossible to intercept. That's why they are among the key technologies prioritised by Germany's High-Tech Agenda. Through targeted funding, Germany is laying the requisite technical foundations, launching flagship projects and establishing lasting structures to turn the everyday use of quantum technologies into reality. All of this makes Germany an attractive destination for researchers from around the world.





Where Germany excels

IN RESEARCH

- leading research institutions, such as the Max Planck Society: it ranks among the top 5 worldwide in terms of the number of QT publications
- world-leading universities with strong quantum research programmes
- Germany ranks 3rd in terms of global patents granted across QT

IN INDUSTRY

- dynamic environment: Germany ranks 3rd in terms of new firms entering the quantum ecosystem (2015–2024)
- large corporations with quantum research interests such as Airbus, Boehringer Ingelheim, SAP and Infineon
- strong engineering and manufacturing heritage

IN INFRASTRUCTURE

- excellent German quantum ecosystem with several primary infrastructure pillars and regional hubs such as JUNIQ or the Munich Quantum Technology Park
- part of a European network: Germany is taking part in the European Quantum Communication Infrastructure, EuroQCI
- Europe's first quantum computer Euro-Q-Exa in Munich

IN SOCIETY

- high levels of public trust in science, coupled with strong science communication, support informed debate on quantum-enabled security and new applications
- a growing quantum community and talent pipeline supported by initiatives, networks and training formats that connect research and industry

Where Germany is heading

The aim is clear: to establish Germany as one of the world's leading hubs for the development and application of quantum technologies – facilitating world-class research, industrial system integration and, ultimately, widespread economic and societal benefits. The roadmap to achieve this sets out the milestones up to 2030–2032, which include:

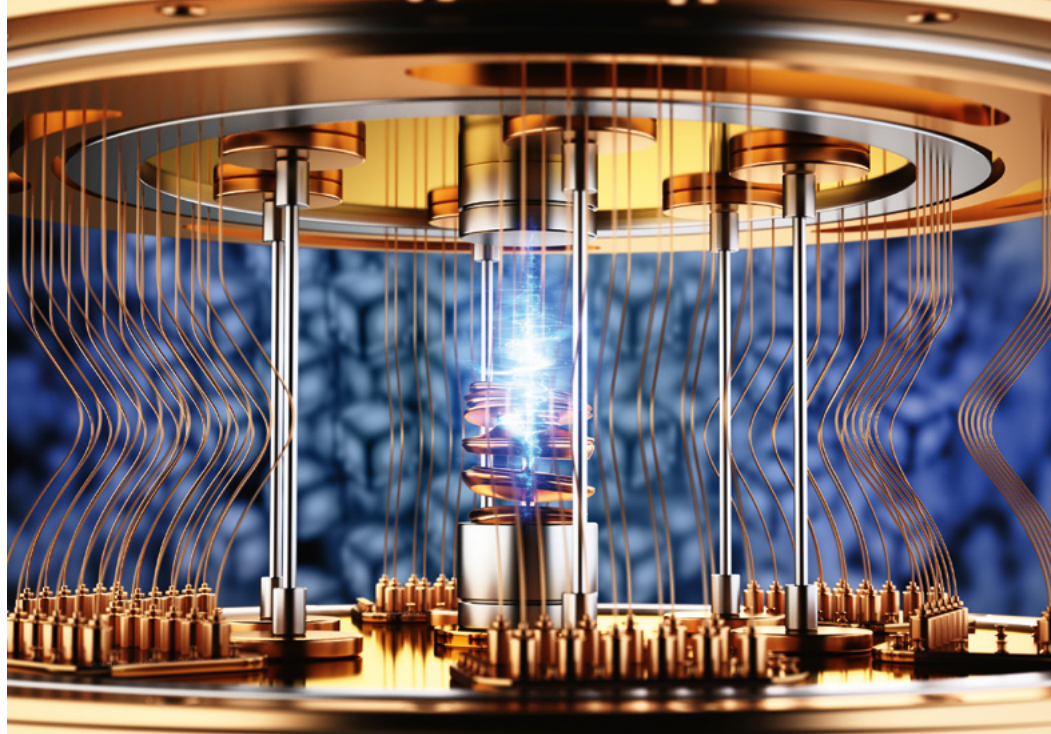
1. DEVELOPING AT LEAST TWO ERROR-CORRECTED QUANTUM COMPUTERS OPERATING AT TOP EUROPEAN LEVEL

- at least 3 German pilot lines to serve as key nodes in the European “From Lab to Fab” network by the end of 2026
- quantum computing start-ups reaching the scale-up phase by 2028
- quantum computing hardware installed by 2029
- a fully developed and integrated software stack by 2030

2. PUTTING QUANTUM SENSING INTO PRACTICE

- transfer centres for quantum sensing established by 2027
- quantum advantage demonstrated for medical applications by 2029
- at least 6 projects showcasing a quantum advantage for real-world applications by 2032





3. EXPANDING QUANTUM COMMUNICATIONS

- 2nd QUBE research satellite brought into operation in 2026
- a working quantum repeater realised by 2028
- quantum information networks established across Germany by 2030

4. CREATING A MORE SOLID BASE OF SKILLED TALENT

- education and training concepts created by 2029
- 25 new quantum technology professorships established by 2030

More: Quantum technologies roadmap (in German only)



Funding opportunities (selection):

- Quantum system research programme (in German only)

Through this programme, the Federal Ministry of Research, Technology and Space is championing photonics and quantum technologies.

Discover current quantum technology research, individual funding opportunities and leading institutions in Germany using the QR code for all direct links on the last page.

Microelectronics: the heart of cutting- edge technology

Germany is the EU's largest microelectronics hub – an advantage the Federal Government intends to leverage and build upon: through targeted initiatives and investment and by expanding partnerships as well as research and production capacities. The High-Tech Agenda fosters research and innovation across the entire life cycle of a chip, from circuit design and development of new semiconductor materials to high-volume manufacturing.



Where Germany excels

IN RESEARCH

- research-intensive universities, such as TU Dresden, the Karlsruhe Institute of Technology (KIT) and Ulm University
- a broad range of applied research, including the transfer of research findings – within the Fraunhofer Group for Microelectronics, for example

IN INDUSTRY

- the EU's largest microelectronics hub: accounting for about 30 per cent of the wafer capacity in European semiconductor manufacturing
- specialised in complex and multifunctional microelectronics and sensor technology for applications such as automotive engineering or secure identification
- strong user industries such as the automotive, energy supply and medical technology sectors

IN INFRASTRUCTURE

- Research Fab Microelectronics Germany: a one-stop shop for micro- and nanoelectronics R&D comprising 15 collaborating research institutes
- Research Labs Microelectronics Germany (ForLab): a network of higher education institutions that sets up research labs, especially for SMEs, start-ups and research groups

IN SOCIETY

- a large pool of scientific talent: Germany is the OECD's number 1 with the highest proportion of STEM graduates

Where Germany is heading

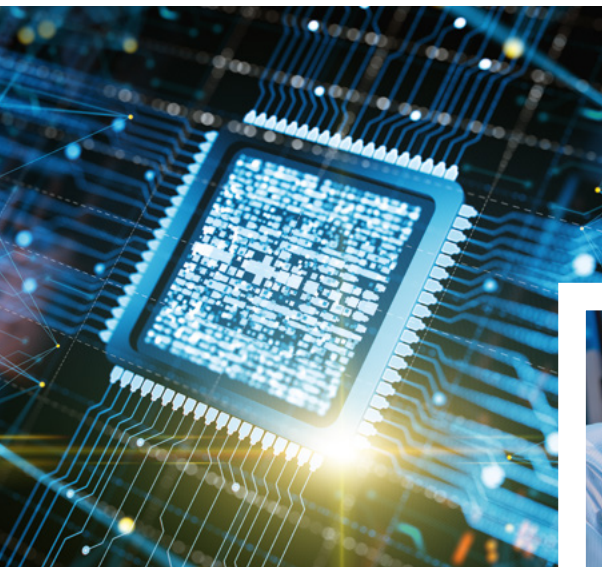
The Microelectronics Strategy aims to enhance Germany's appeal as a location for the design, transfer, manufacture and application of microelectronics, while strengthening the technological sovereignty and resilience of both Germany and Europe. To this end, it has developed a series of roadmap milestones, which include:

1. HIGH-PERFORMANCE CHIPS DESIGNED IN GERMANY

- a Competence Centre for Chip Design and 5 topic-specific hubs established by 2027
- specialised processors with matching software development kits for the automotive sector developed by 2029
- better AI chips for edge computing on the market by 2029

2. IMPROVING TRANSFER FROM LAB TO REAL-WORLD APPLICATION

- access to cutting-edge technologies, especially for SMEs and start-ups, by 2027
- pilot manufacturing capacities for advanced packaging expanded by 2029
- new microelectronics technologies scaled up by 2030





3. INCREASING THE MARKET SHARE OF GERMAN AND EUROPEAN MICROELECTRONICS COMPANIES

- conditions for scaling up chip SMEs and start-ups improved by 2027
- manufacturing capacities in Germany increased by 2029
- development of high-end image sensors advanced by 2029

4. STRENGTHENING THE RESILIENCE OF SUPPLY CHAINS

- a national "Chips Office" set up in 2026
- partnerships with international technology leaders expanded in 2026
- a European-coordinated supply chain monitoring system established by 2027

More: Microelectronics roadmap (in German only)



Funding opportunities (selection):

- BMFTR announcement of funding in the area of microelectronics (in German only)

Discover current microelectronics research, individual funding opportunities and leading institutions in Germany using the QR code for all direct links on the last page.

Biotechnology: innovation for health, food security and industrial resilience

Biotechnology is far more than a single technology – it's a powerful engine of change that is reshaping healthcare, enabling the sustainable production of food and driving a circular, competitive economy. Germany is one of the world's leading centres for biotechnology – encompassing everything from medical innovations to the industrial bio-economy. The High-Tech Agenda brings together science and industry, with a clear focus on technology transfer, start-ups and scaling up.





Where Germany excels

IN RESEARCH

- impressive science and research institutions: Germany ranks 4th worldwide in terms of S&E articles published in the biological and biomedical sciences
- strong in innovation: Germany is the world's number 4 in terms of biotechnology-related IP5 patents

IN INDUSTRY

- a broadly positioned biotech sector: more than 1,000 biotech companies
- globally recognised biotech companies, e.g. BioNTech, Evotec or Boehringer Ingelheim
- a strong mechanical and plant engineering sector
- an established ecosystem of specialised SME suppliers

IN INFRASTRUCTURE

- well-developed research infrastructures, such as the Berlin-based Charité
- strong biotech hubs providing essential services and infrastructure for biotech companies, e.g. the Heidelberg-based bioRN biotech cluster or the Cluster for Industrial Biotechnology (CLIB) in Düsseldorf
- a networked health data ecosystem connected to the industrial health economy

IN SOCIETY

- a large pool of scientific talent: Germany is the OECD's number 1 with the highest proportion of STEM graduates

Where Germany is heading

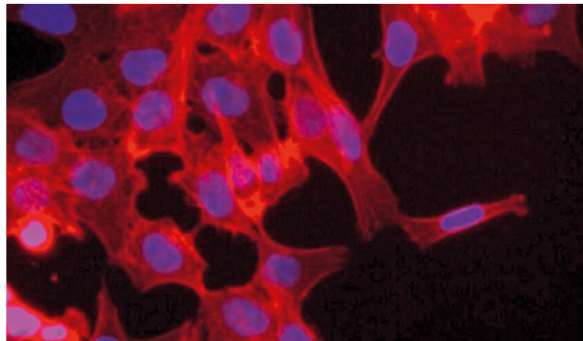
Germany aims to establish itself as the world's most innovative location for biotechnology. To achieve this goal, the High-Tech Agenda Germany sets out a series of milestones and measures across medicine, industry and agriculture. These have been laid down in a roadmap and include:

1. BECOMING A LEADING LOCATION FOR HEALTH RESEARCH

- a translational centre for gene and cell therapies established by 2028
- Germany to be among the top 3 locations in the world for clinical trials by 2030
- a sharp increase in the share of venture capital in the biotechnology sector by 2030

2. BECOMING THE MOST INNOVATIVE LOCATION FOR BIOTECHNOLOGY

- private investment increased to 5 billion euros per year by 2028
- Germany evolves to become Europe's leading location for bioengineering by 2029





3. DEVELOPING RESILIENT, CRISIS-PROOF AGRICULTURAL AND FOOD SYSTEMS

- market share of biotechnological crop protection systems doubled by 2030
- Germany becomes European leader in use of biotechnological breeding methods by 2030

4. ADVANCING PREDICTIVE AND PREVENTIVE MEDICINE

- innovative sensors developed for diagnostics and therapy by 2030
- innovative medical technology in the field of women's health improved by 2030

More: Biotechnology roadmap
(in German only)



Funding opportunities (selection):

- Industrial bioeconomy (in German only) supports the transfer of bio-based products and processes into industrial practice.
- Innovative SMEs: biomedicine (in German only) supports small and medium-sized enterprises.

Discover current biotechnology research, individual funding opportunities and leading institutions in Germany using the QR code for all direct links on the last page.

Fusion and climate-neutral energy generation: shaping the future of clean power

Clean, safe and virtually limitless – fusion energy could transform how the world is powered. And with plans to build the world's first fusion power plant, Germany aims to lead the way. This is one of the Federal Government's central goals in the area of energy policy. A solid foundation is already in place, as Germany ranks among the world's leading nations in magnetic fusion research and will make more than two billion euros available for fusion research up to 2029.



Where Germany excels

IN RESEARCH

- one of the leading nations in magnetic fusion research, with expertise in plasma-wall interaction, material fatigue and the fuel cycle
- home to outstanding research institutes for fusion technology, such as the Max Planck Institute for Plasma Physics, the Karlsruhe Institute of Technology (KIT) and the Forschungszentrum Jülich (FZ Jülich)
- strong research base in other climate-neutral energy technologies, including hydrogen and deep geothermal energy

IN INDUSTRY

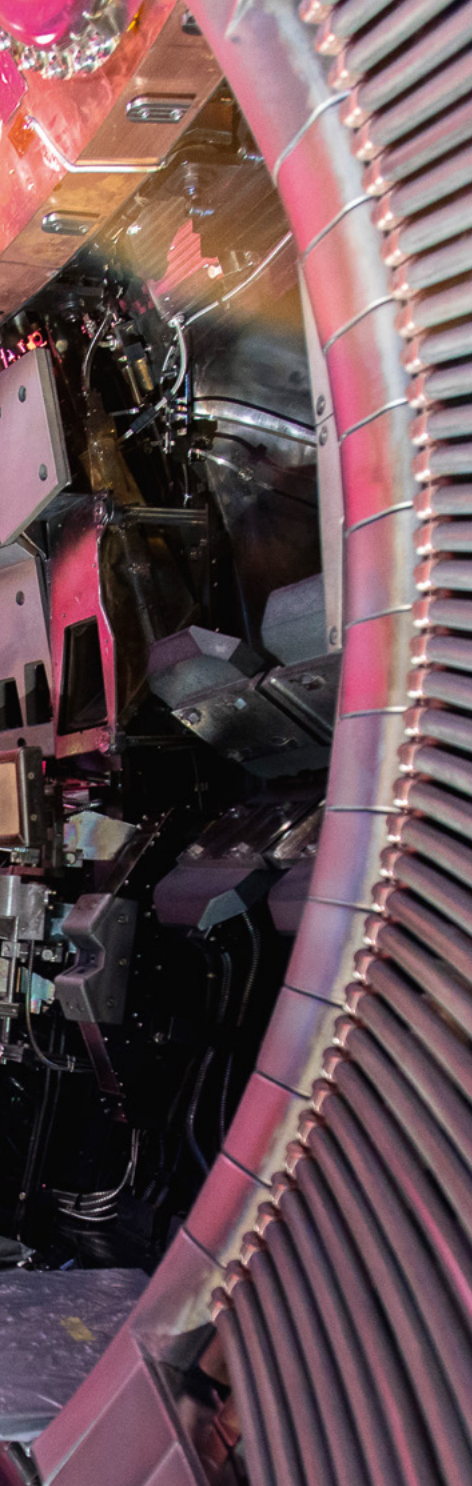
- technology-driven, research-intensive companies: of the 53 companies worldwide aiming to build a fusion power plant, 4 are based in Germany
- home to companies pioneering key approaches such as stellarator and laser-based fusion
- a competitive industry across the wider energy transition, from hydrogen technologies to renewable power generation

IN INFRASTRUCTURE

- significant infrastructures, such as the world's largest and most advanced stellarator Wendelstein 7-X, the Tokamak ASDEX Upgrade in Garching and the fusion laboratories at FZ Jülich and KIT

IN SOCIETY

- established energy research networks for fostering exchange between research, policy and industry
- broad social acceptance of renewable energies



Where Germany is heading

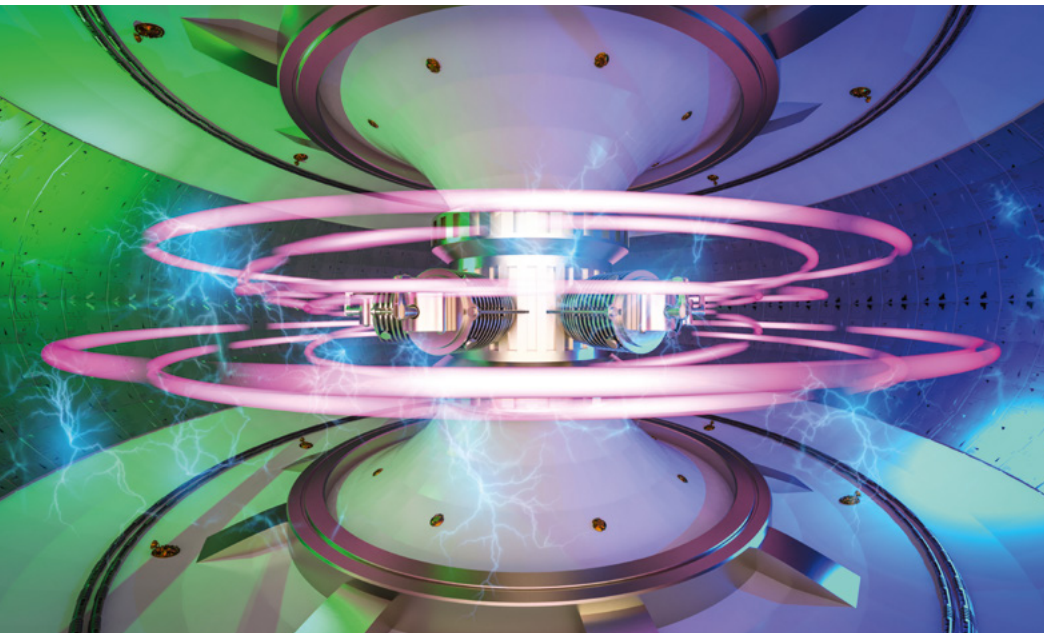
Germany wants to become a leading innovation hub for fusion technologies, with German companies becoming world market leaders in this field. To this end, the High-Tech Agenda Germany has set out a roadmap with three sub-goals that are to be achieved through the following steps, among others:

1. MAKING THE CONSTRUCTION OF A FUSION POWER PLANT POSSIBLE

- a 1st high-temperature superconducting coil model produced by 2028
- a decision on whether to focus on magnetic fusion energy (MFE) or inertial fusion energy (IFE) taken by the 2nd half of the 2030s
- the world's 1st commercial fusion power plant brought into operation in the 2040s

2. ACHIEVING PROGRESS IN THE FUEL CYCLE AND MATERIAL DEVELOPMENT

- a concept for the fuel cycle developed by 2028
- scalable plant technology for the enrichment of lithium-6 established in Germany by 2028
- research infrastructures for material development established by 2034





3. CREATING THE FRAMEWORK FOR A FUSION POWER PLANT

- inclusion of fusion in the Radiation Protection Act in 2026
- public acceptance of nuclear fusion by 2029

Research into additional key technologies for the energy transition is being pooled and shared in an energy research programme. From 2026, a new research initiative on deep geothermal energy and a hydrogen research hub will support developments in both fields. Publication of the Hydrogen Roadmap is planned for 2027.

More: Fusion roadmap
(in German only)



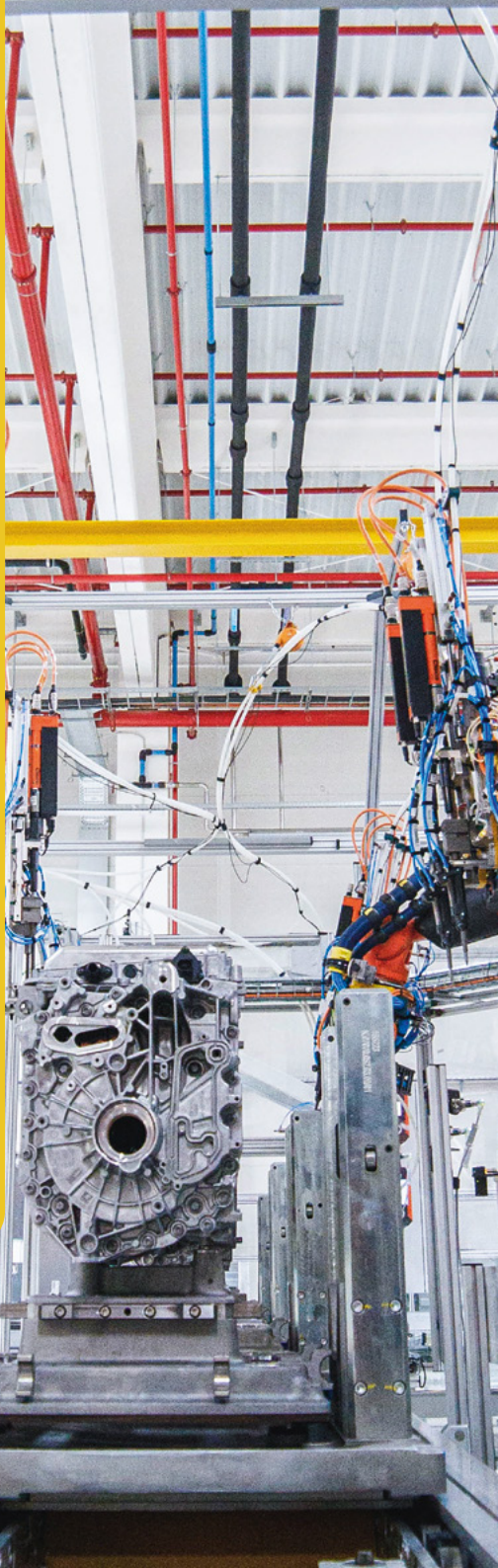
Funding opportunities (selection):

- Fusion 2040 – research on the path to a fusion power plant (in German only)
- Geothermal energy
- Funding advice – Hydrogen Guidance Service

Discover current fusion and climate-neutral energy generation research, individual funding opportunities and leading institutions in Germany using the QR code for all direct links on the last page.

Technologies for climate-neutral mobility: driving global innovation for a sustainable future

Battery technology lies at the very heart of climate-friendly mobility, and Germany is committed to strengthening Europe's position in this field. The goal is to build a technologically sovereign, competitive and sustainable battery production sector. The climate-neutral mobility of the future will be powered not only by high-performance batteries for electric cars, but also by electric and hydrogen propulsion for ships and aircraft, as well as by new forms of mobility such as autonomous vehicles, hyperloop trains and drones. Here, too, Germany is striving to lead the way.





Where Germany excels

IN RESEARCH

- leading research institutes, e.g. the MEET Battery Research Center at the University of Münster, the Helmholtz Institute Ulm, the German Aerospace Center (DLR) and the Karlsruhe Institute of Technology (KIT)
- German participation in 4 projects of the "IPCEI on Batteries", the 1st major European project on battery cell manufacturing
- outstanding expertise in the research and production of propulsion systems, spanning alternative engine types, climate-friendly fuels such as e-fuels and carbon capture and utilisation technologies
- a strong research base in aviation and maritime technologies as well as in AI- and data-based solutions for mobility

IN INDUSTRY

- a strong ecosystem, including transfer, in the field of mobility
- established innovation ecosystems for smart mobility solutions, batteries and e-fuels
- Germany is a lead market in mobility, being Europe's largest market for and producer of electric cars and plug-in hybrids

IN INFRASTRUCTURE

- the large-scale Fraunhofer Research Institution for Battery Cell Production (still partly under construction)
- infrastructures at universities and consortia, such as the Battery Labfactory Braunschweig
- test and development environments for new forms of mobility, including model regions for the mobility of the future (from 2026) and a planned hyperloop reference track

IN SOCIETY

- broad social acceptance of renewable energies and climate-friendly mobility solutions

Where Germany is heading

The High-Tech Agenda Germany strengthens research, production, transfer to application and circular systems for batteries to make innovations usable more quickly. The Battery Roadmap sets out sub-goals and concrete steps aimed at building a competitive battery production and circular system in Germany, embedded within a European network. Key milestones include:

1. EXPANDING BATTERY RESEARCH

- development of low-cost and resource-independent next-generation batteries by 2028
- promising scientific innovations further developed and scaled up for industry by 2029
- technological sovereignty strengthened through joint international battery projects by 2030

2. BECOMING A LEADING SUPPLIER IN SELECTED SPECIALIST BATTERY MARKETS

- the growing market for batteries in the “non-automotive” sector tapped by 2030
- technological leadership achieved in selected fields of application by 2030
- industry transfer strengthened through vertical battery application alliances by 2033





3. BECOMING A KEY PLAYER IN THE NEXT GENERATION OF BATTERIES IN GLOBAL MASS MARKETS

- gigas-scale manufacturing capacities in place in Germany by 2027
- capacities in the non-lithium-ion sector established by 2030
- successful development and scaling of next-generation battery cells by 2032
- capacities for resilient value chains, including recycling, established and expanded by 2035

Alongside battery technologies, Germany is working to enhance alternative propulsion systems and climate-friendly fuels (including e-fuels and carbon capture and utilisation) and advancing AI- and data-based mobility solutions. From 2026, model regions for future mobility systems and a planned hyperloop reference track will enable progress to be made in the field in general.

More: Battery technology roadmap (in German only)



Funding opportunities (selection):

- Battery research (in German only)
- DNA of future-proof mobility (in German only)

Discover current research into technologies for climate-neutral mobility, individual funding opportunities and leading institutions in Germany using the QR code for all direct links on the last page.

Key technologies for tomorrow: the High-Tech Agenda Germany

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